

A graphically illustrated glossary of polychaete terminology: invasive species of Sabellidae, Serpulidae and Spionidae

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Abstract

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A well-illustrated glossary supports the study of polychaete anatomy and systematics, as well as aiding species identification, a need that emerged within the shipping and aquaculture industries over recent decades. Sabellidae, Serpulidae and Spionidae are polychaete families that most often include species that are translocated globally through ship fouling, ballast water or aquaculture trade. Accurate identifications are crucial since these translocations have significant ecological and commercial implications and also for phylogenetic and other biological studies. Using digital illustrations of specimens (deposited predominantly at the Australian Museum in Sydney), a glossary has been developed for these three families with the aim of standardising terminologies. Complete-focus images were generated with Helicon Focus 5.3 Pro software from multiple image layers. The definitions have been explained specific to families and illustrated with these images, thus creating the first comprehensive, digitally illustrated glossary of polychaete terminology.

Keywords

invasive, biofouling, biosecurity, identification key, digital photographs, Australia

Introduction

The identification of polychaetes, as with all invertebrate groups, requires an understanding of both the morphological features and the terminologies used to describe these features. Therefore, a glossary underpins the study of the systematics of a particular group. Soon after its publication, the glossary of the ‘pink’ book (Fauchald, 1977) became a standard reference for terms used in systematic polychaete literature. However, terminology used for polychaete features has varied greatly among authors, resulting in confusion that has never been resolved, even within individual families (e.g. Nogueira *et al.*, 2010, for Terebellidae; Capa and Murray, 2009, and Capa *et al.*, 2011a and 2011b, for Sabellidae; ten Hove and Kupriyanova,

2009, for Serpulidae; Light, 1978, and Radashevsky, 2012, for Spionidae). Moreover, the terms used for homologous structures may differ considerably between families, while identical terms are sometimes used for features with different origins (e.g. ‘branchia’ in Serpulidae and Spionidae)—hence the potential for confusion.

In recent decades, the need for polychaete identification has arisen among the shipping and port management industries as a result of increasing global trade, as well as within the aquaculture industry. Environmental consultants, biologists and quarantine officers are required to examine ship hulls and wharves in ports and marinas for anthropogenically translocated organisms, including polychaetes. Invasions of pest species threaten local marine communities and biodiversity, generating substantial

losses for the aquaculture, shipping and tourism industries (Holloway and Keough, 2002; Bax *et al.*, 2003; Çinar, 2012). The polychaete families Serpulidae, Sabellidae and Spionidae collectively comprise 40% of the translocated polychaetes worldwide (Çinar, 2012), and some of these are listed as pest species (DAFF, 2012) as they can have considerable impact on native ecosystems, including the potential to displace local species (Çinar *et al.*, 2005; Çinar, 2012). For many species, the impacts are yet to be studied.

The obvious need for a well-illustrated digital guide for non-specialists resulted in the Invasive Polychaete Identifier (Kupriyanova *et al.*, 2013) that was developed at the Australian Museum with the aim of enabling identification of Australian native and invasive (or potentially invasive) polychaetes. This guide includes a glossary that is linked to the terms used in the text. The approach taken by the guide is comprehensive visualisation for identifications of sabellid, serpulid and spionid species. Museum specimens were photographed through a Leica MZ16 dissection microscope fitted with a Spot Flex 15.2 camera. Some specimens were stained with methylene blue or methyl green to increase contrast and thus visually enhance important diagnostic features. Slides were made of chaetae of some species. Helicon Focus 5.3 Pro software was used to create completely focused images by integrating the layers of partially focused images captured.

There have been previous attempts to standardise definitions within each of the three families under consideration. The influential taxonomic revision of Sabellidae by Fitzhugh (1989) has for years been the source of terminology for this family, and Capa *et al.* (2011a) recently reviewed the terminology of most sabellid morphological features. Ten Hove and Kupriyanova (2009) reviewed the state of taxonomy in Serpulidae (not including, however, the subfamily Spirorbinae) and provided a discussion of morphology and a glossary for the family. Most recently, Radashevsky (2012) reviewed the morphology of Spionidae and the terms used in this family. As a next step towards easier communication of taxonomic information, here we provide the first fully illustrated glossary of the polychaete terms that are specific to these three families (Sabellidae, Serpulidae and Spionidae). While we have attempted to standardise terms, we are not implying that structures with the same name are necessarily homologous structures, and in many cases detailed developmental studies are required to ascertain this. The terminologies pertaining to general biology and systematics are not covered, as it is expected that users can refer to standard textbooks and literature (e.g. Beesley *et al.*, 2000; Rouse and Pleijel, 2001) if they are not already equipped with this knowledge.

GLOSSARY

A

abdomen (Sabellidae and Serpulidae): body region posterior to the thorax; recognised by notopodial (dorsal) uncini and neuropodial (ventral) chaetae (fig. 1a).

accessory gills (Spionidae): see **branchiae**.

acicular spine (Spionidae): straight thick chaetae in notopodia of posterior segments (fig. 1b).

acicular uncinus (pl. **acicular uncini**) (Sabellidae): hook-shaped uncinus with a poorly developed breast and a long handle (fig. 1c).

anal depression (Sabellidae): dorsoventrally flattened expansion of posterior abdominal segments, accompanied in some species by lateral flanges (fig. 1d).

anterior peristomial ring (Sabellidae): anterior part of the peristomium, attached to the radiolar lobe; ventral anterior lobe can be triangular or rounded (fig. 1e).

apron (Serpulidae): membranous flap formed by thoracic membranes joined ventrally past the last thoracic chaetigers (fig. 1f).

avicular uncinus (pl. **avicular uncini**) (Sabellidae): Z-shaped uncinus with well-developed breasts and a handle (fig. 1g).

B

bayonet chaetae (Serpulidae): special collar chaetae with 1 or 2 (sometimes more) large proximal teeth at the base of a distal limbate zone (fig. 1h).

bayonet chaetae (Sabellidae): small, thin and slightly bent, narrowly hooded (see **limbate chaetae**) thoracic and abdominal chaetae (fig. 1i).

bifurcate: divided into 2 parts or branches.

bilimbate: chaetae with a hood (limbus) visible on both sides of the shaft; see **limbate chaetae** and **broadly hooded**.

branchiae (Spionidae): paired body appendages on segments, provided with blood loop for respiration (fig. 1j). N.B., different from radiolar crown of Sabellidae and Serpulidae.

breast (Sabellidae and Serpulidae): rounded part of an uncinus; located below the main fang in Sabellidae or anterior fang (peg) in Serpulidae (fig. 2a). Uncini with well-developed breasts are avicular (Sabellidae).

broadly hooded (Sabellidae and Serpulidae): hooded capillaries with the distal hood (limbus) enlarged on both sides of the shaft and appearing bilimbate under the compound microscope (fig. 2b).

C

capillary chaetae: slender, often long, chaetae, tapering to a fine point; the term has been used as a collective term for elongate, needle-like or hair-like chaetae of otherwise variable shape and ontogeny (fig. 2c).

caruncle (Spionidae): a dorsal extension of the prostomium, taking the form of an elevation or a distinct crest separating the nuchal organs one from another (fig. 2d).

chaeta (pl. **chaetae**) (hence Polychaeta, 'with many hairs'): chitinous bristle protruding from an epidermal pocket in the body wall (fig. 2e).

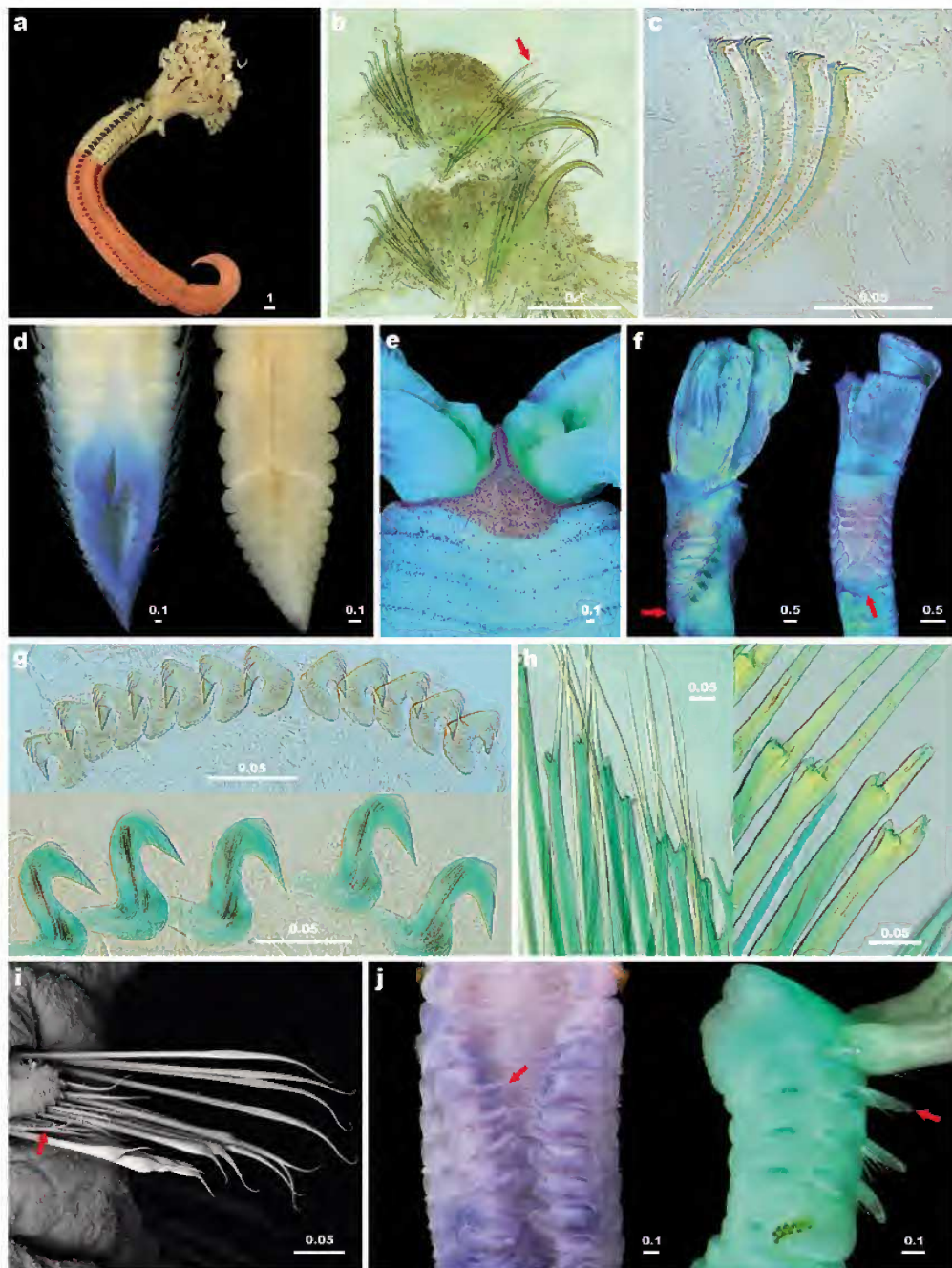


Figure 1. (a) *Bispira manicata* with abdomen region highlighted red. (b) Posterior notopodia of *Boccardiella bihamata* stained with methyl green; arrow points to acicular spine. (c) Acicular thoracic uncini of *Euchone limnicola*. (d) Ventral anal depression in *Euchone variabilis* (left, stained with methylene blue) with lateral flanges, and in *Euchone limnicola*, without flanges. (e) Collar region/base of radiolar crown in *Myxicola infundibulum* stained with methylene blue; anterior peristomial ring highlighted red. (f) Lateral view of *Spirobranchus tetraceros* (left) and ventral view of *Spirobranchus kraussii* (right), both stained with methylene blue; arrows point to apron. (g) Z-shaped avicular thoracic uncini of *Laonome triangularis* (above) and *Bispira manicata* (below, stained with methyl green). (h) Bayonet collar chaetae in *Serpula jukesii*, stained with methyl green. (i) Bayonet thoracic chaetae in *Jasmineira* sp. (j) Arrows point to branchiae in *Boccardia chilensis* (left and right specimens stained with methylene blue and methyl green, respectively). All scales in mm.

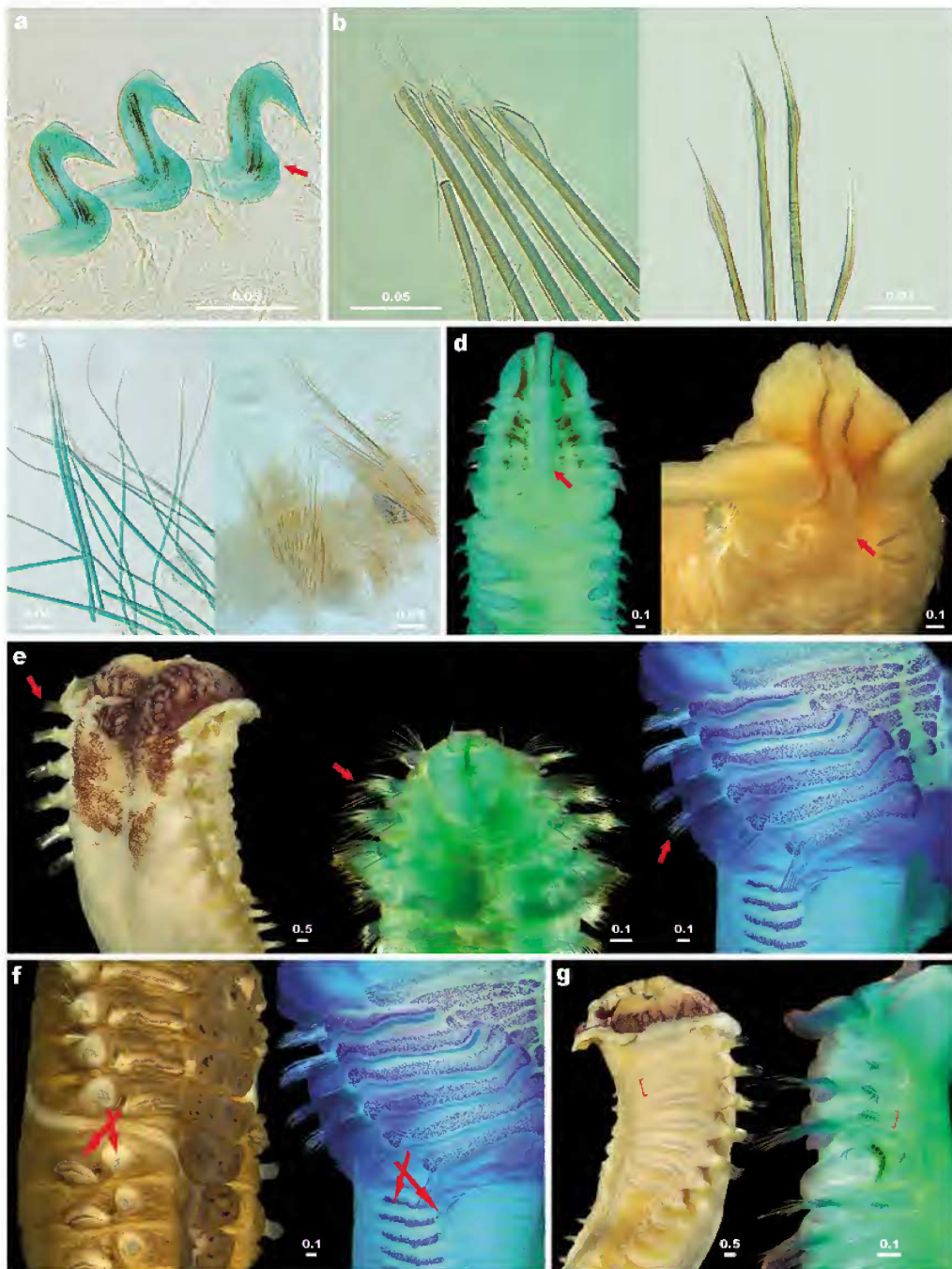


Figure 2. (a) Thoracic uncini of *Bispira manicata*, stained with methyl green; arrow points to breast of uncinus. (b) Broadly hooded thoracic chaetae of *Euchone limnicola* and collar chaetae of *Laonome calida*. (c) Capillary chaetae from collar of *Spirobranchus taeniatus* (on left, stained with methyl green) and chaetiger 1 of *Boccardia proboscidea* (on right). (d) Dorsal view of anterior ends of *Polydora haswelli* (on left, stained with methyl green) and *Boccardia proboscidea* (on right); arrows point to caruncle. (e) Arrows point to thoracic chaetae of (left to right, respectively) *Bispira porifera*, *Boccardiella bihamata* (stained with methyl green) and *Spirobranchus cariniferus* (stained with methylene blue). (f) Arrows demonstrate chaetal inversion in *Branchiomma bairdi* (left) and *Spirobranchus cariniferus* (right). (g) Lateral views of thoracic regions of *Bispira porifera* (left) and *Polydora haswelli* (right, stained with methyl green); each bracket indicates 1 chaetiger. All scales in mm.

chaetal inversion (Sabellidae and Serpulidae): the thorax bears chaetae dorsally (in notopodia) and uncini ventrally (in neuropodia); while in the abdomen the position of the chaetae and uncini is reversed (fig. 2f).

chaetiger: segment bearing chaetae (fig. 2g).

cirrus (pl. cirri): soft tactile appendage, usually on parapodia, peristomium and pygidium (fig. 3a).

cirriform (Spionidae): bearing cirri (fig. 3a).

collar (Sabellidae and Serpulidae): a more or less encircling membranous flap projecting from the peristomium and, in some cases, covering the base of the radiolar crown (fig. 3c).

collar chaetae (Sabellidae and Serpulidae): notochaetae of the first (collar) chaetiger not accompanied by neuropodial uncini (fig. 3d).

collar segment (Sabellidae and Serpulidae): first chaetiger, often bearing a membranous collar and notochaetae (see **collar chaetae**), but lacking uncini (fig. 3e).

companion chaetae (Sabellidae): chaetae with a basal shaft and a distal hood, arranged in a single row, parallel to the row of thoracic uncini (fig. 3b).

companion chaetae (Spionidae): short capillary chaetae, usually distally bilimbate, accompanying heavy falcate spines on segment 5 in polydorins (members of the tribe Polydorini) (fig. 5g).

constriction (Serpulidae): narrowing of the opercular peduncle at base of opercular funnel or ampulla (fig. 3f).

constriction (Spionidae): narrowing of the upper part of hook shaft (fig. 3g).

D

distal wings (Serpulidae): paired lateral outgrowths of the peduncle located just below the operculum (fig. 3h).

dorsal: pertaining to, or situated at, the back (dorsum) (fig. 4a).

dorsal lips (Sabellidae): paired rounded lappets on dorsal margin of mouth; used for feeding, tube building, and sorting the particles collected by the radiolar crown (fig. 4b).

dorsal radiolar appendages (Sabellidae): modified radioles fused to dorsal lips (fig. 4b).

F

falcate spines (Spionidae): chaetae resembling mammalian canine teeth; characteristically present in the posterior row notochaetae of segment 5 in polydorins (members of the tribe Polydorini) (fig. 4c).

faecal groove (Sabellidae and Serpulidae): ciliated channel running along the body and used for directing the faeces from the anus to the anterior tube opening (fig. 4d).

faecal groove inversion (Sabellidae and Serpulidae): change in the position of the ciliated groove (used to direct faeces from the

anus to the tube mouth): it runs ventrally in the abdomen, passing between the last thoracic notopodia and the first abdominal neuropodia, and becomes dorsal in the thorax (fig. 4e).

flat trumpet-shaped chaetae (Serpulidae): in profile resembling a hollow trumpet, with distal expanded part edged with 2 rows of teeth. However, examination with SEM shows that these chaetae are flat, with a single row of acute marginal teeth (fig. 4f).

funnel (Serpulidae): inverted, cone-like proximal part of the operculum in *Hydroides*, and the entire operculum in *Serpula* (fig. 4g).

G

glandular girdle (Sabellidae): complete or incomplete pale ridge around the first or second chaetiger (fig. 4h).

H

handle (Sabellidae): posterior elongated extension of an uncinus; always embedded in body wall (fig. 4i).

hood (preferred term for Sabellidae): distal extension of capillary chaetae, appearing as a flat, longitudinal flange under the compound microscope, but made of tightly packed microfibrils as seen under SEM (fig. 5a). N.B., the same as limbus in Serpulidae.

hood (Spionidae): a thin sheath surrounding the distal dentate end of hooks (fig. 5b). N.B., not the same as hood in Sabellidae.

hooded chaetae (preferred term for Sabellidae): capillary chaetae with hood. N.B., the same as limbate chaetae in Serpulidae.

hooded chaetae (Spionidae): hooked chaetae with hood (see **hood** for Spionidae). N.B., not the same as hooded chaetae in Sabellidae.

hooks (Spionidae): distally curved chaetae used to hold individual inside the burrow or tube (fig. 5c); also see **uncinus**, which can be hook-shaped in Sabellidae.

I

inter-radiolar membrane (Sabellidae and Serpulidae): membrane connecting basal parts of radioles (fig. 5d).

inter-ramal eyespots (Sabellidae): simple eyes located between the rami (notopodia and neuropodia) in both thoracic and abdominal segments (fig. 5e).

K

keel (Serpulidae): outer longitudinal prominent ridge running along the calcareous tube length (fig. 5f).

L

lappet: lobe or flap-like projection.

lateral: located on the side.

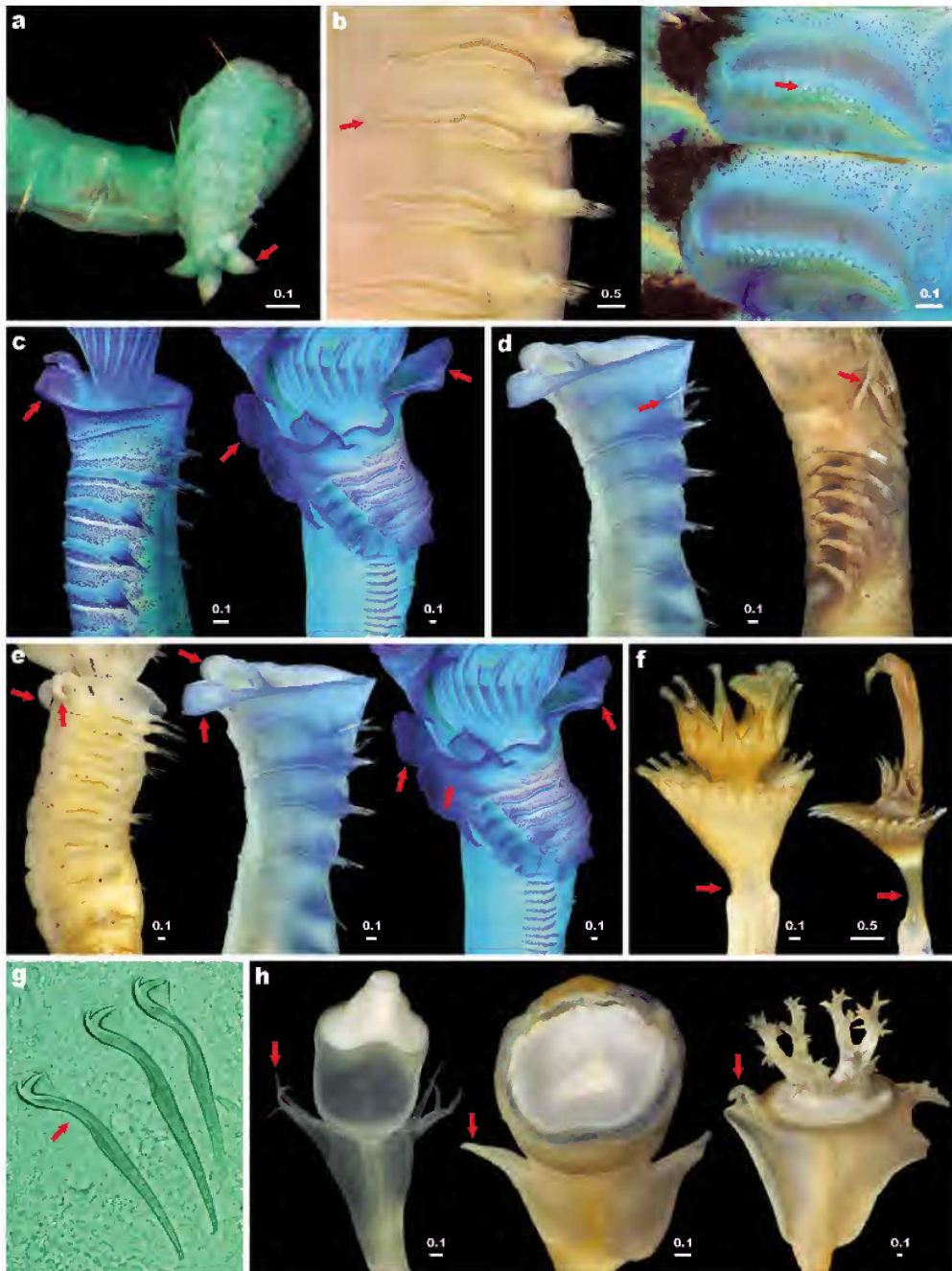


Figure 3. (a) Cirriform pygidium of *Pygospio elegans*, stained with methyl green; arrow points to a cirrus. (b) Companion chaetae (arrows) as parallel row anterior to thoracic uncini in *Sabella spallanzanii* (left) and *Bispira manicata* (right, stained with methylene blue). (c) Arrows point to collar flaps in *Laonome calida* (left) and *Spirobranchus cariniferus* (right), both stained with methylene blue. (d) Collar/thoracic regions of *Laonome triangularis* (left, stained with methylene blue) and *Ficopomatus enigmaticus* (right); arrows point to collar chaetae. (e) Collar segments indicated by different arrows in (left to right, respectively) *Branchiomma galei*, *Laonome triangularis* (stained with methylene blue) and *Spirobranchus cariniferus* (stained with methylene blue). (f) Constrictions, indicated by arrows, occurring below funnels in opercula of *Hydroides malleolaspinus* and *Hydroides minax*. (g) Constriction, indicated by arrow, in upper shaft of neuropodial hooks of *Polydora uncinata*. (h) Opercula of *Spirobranchus polytremas*, *S. cariniferus* and *S. tetracerus* (left to right, respectively); arrows indicate distal wings. All scales in mm.

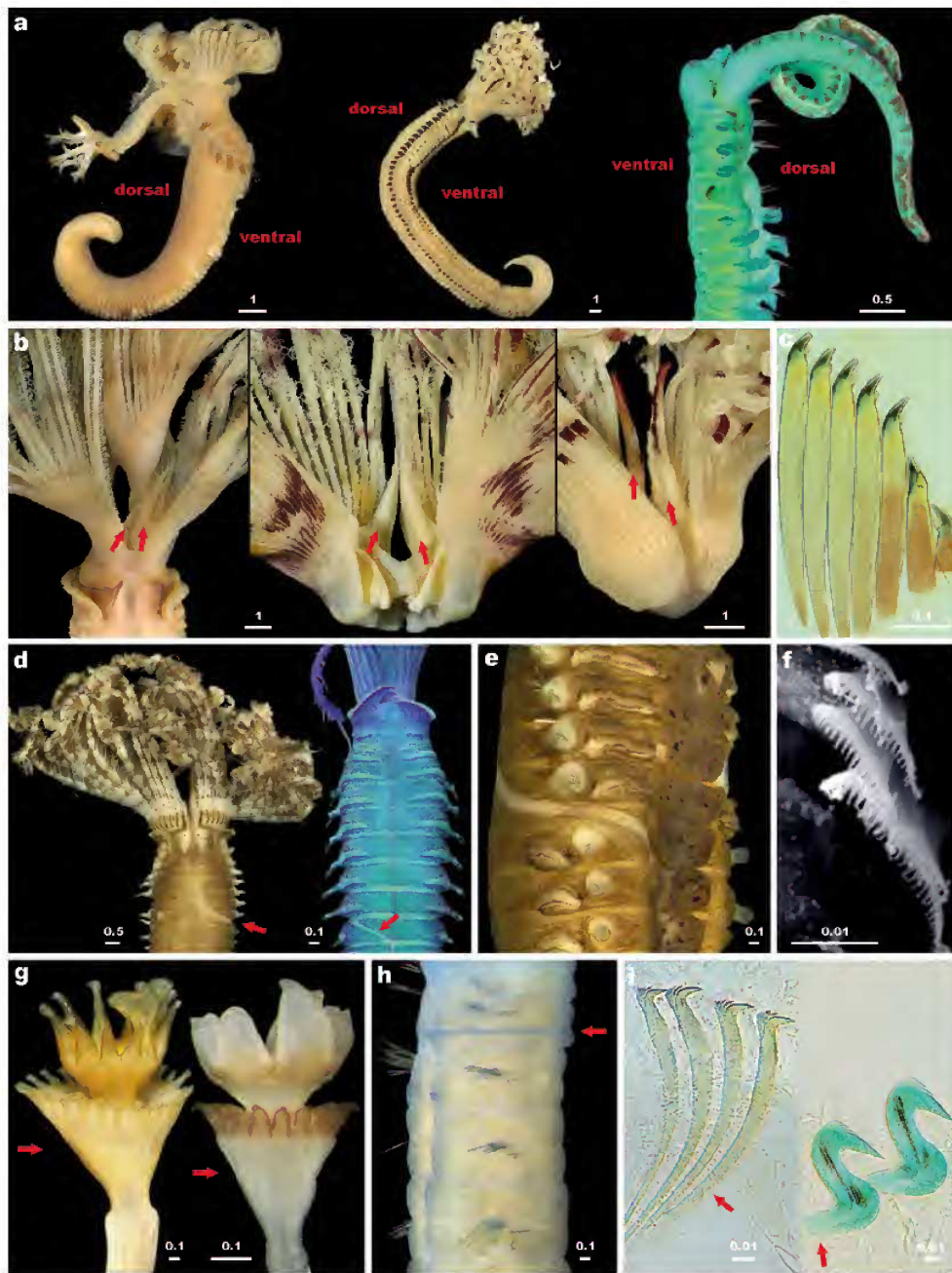


Figure 4. (a) Dorsal/ventral sides illustrated on examples of (left to right, respectively) Serpulidae (*Spirobranchus tetraceros*), Sabellidae (*Bispira manicata*) and Spionidae (*Polydora haswelli*, stained with methyl green). (b) Arrows indicating paired dorsal radiolar appendages, fused to dorsal lips, in (left to right, respectively) *Sabella spallanzanii*, *Bispira porifera* and *Bispira manicata*. (c) Falcate spines in notochaetae on chaetiger 5 of *Polydora uncinata*. (d) Anterior regions of *Branchiommma bairdi* (dorsal view) and *Laonome calida* (ventral view, stained with methylene blue); arrows indicate faecal grooves. (e) Faecal groove inversion in *Branchiommma bairdi*: faecal groove runs ventrally in abdomen and dorsally in thorax. (f) SEM image of flat trumpet-shaped abdominal chaetae in *Serpula columbiana*. (g) Arrows indicate opercula funnels in *Hydroides malleolaspinus* and *Hydroides tuberculatus*. (h) Arrow indicates glandular girdle on chaetiger 2 of *Euchone variabilis*, stained with methylene blue. (i) Arrows indicate handles of acicular thoracic uncini in *Euchone limnicola* (left) and avicular thoracic uncini in *Bispira manicata* (right, stained with methyl green). All scales in mm.

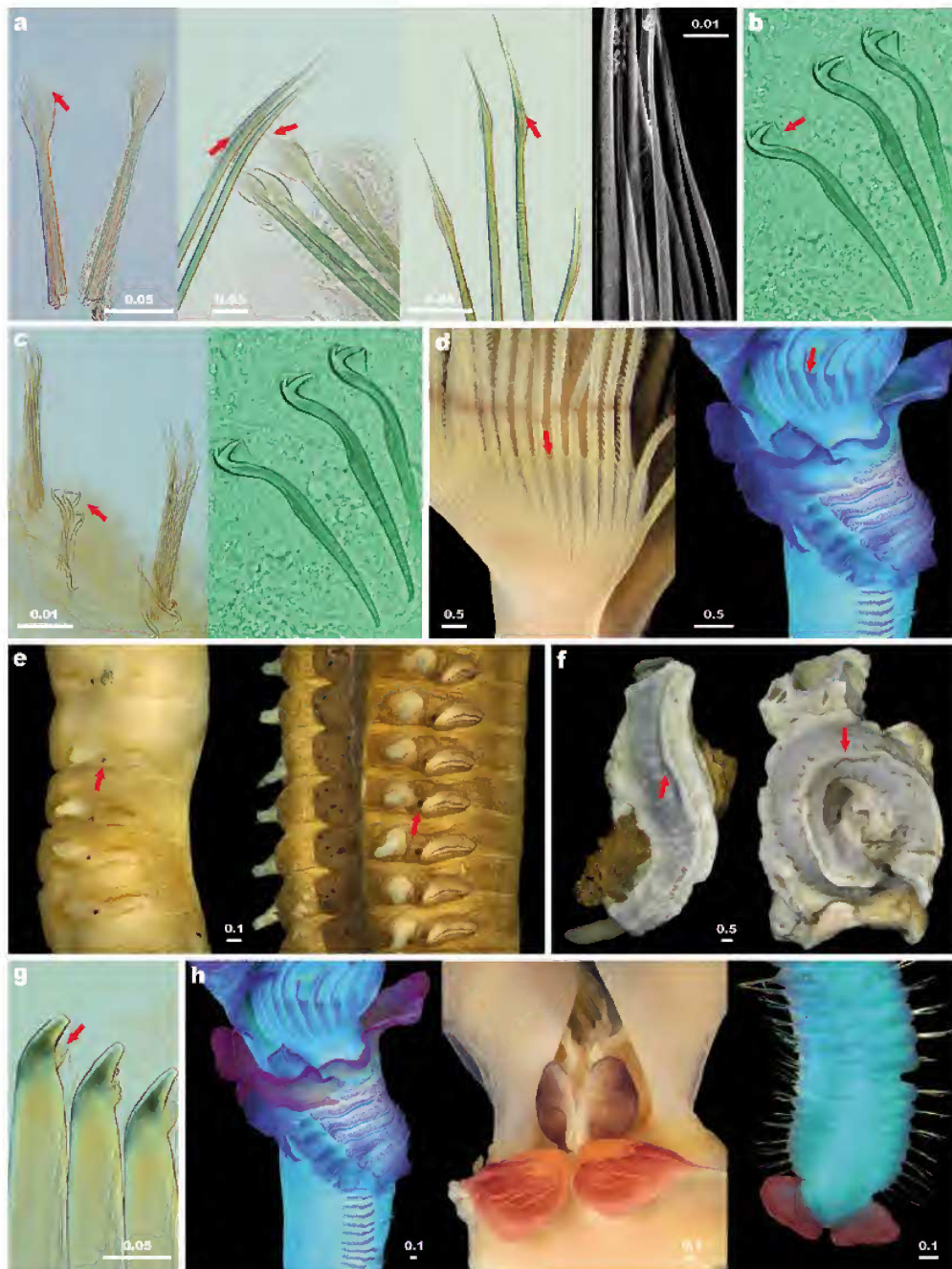


Figure 5. (a) Arrows indicate hood on collar chaetae of *Laonome triangularis* (left 2 images), *Laonome calida* and thoracic chaetae of *Crucigera websteri* (SEM image). (b) Arrow indicates hood in neuropodial hooks of *Polydora uncinata*. (c) Hooks in posterior neuropodia of *Polydora uncinata*. (d) Radioles proximally connected by inter-radiolar membranes (arrows) in *Sabella spallanzanii* and *Spirobranchus cariniferus* (stained with methylene blue). (e) Inter-ramal eyes (arrows) located between notopodia and neuropodia of *Branchiomma galei* and *Branchiomma bairdi*. (f) Calcareous tubes of *Spirobranchus cariniferus* (left) and *Spirobranchus kraussii* (right); arrows indicate keels on tube. (g) Falcate spines in notopodia of chaetiger 5 of *Polydora uncinata*; arrow indicates lateral flange. (h) Lobate condition in collars of (left to right, respectively) *Spirobranchus cariniferus* (stained with methylene blue), *Sabella spallanzanii* and pygidium of *Polydora ciliata* (stained with methyl green). Lobes highlighted red. All scales in mm.

lateral flange (Spionidae): small subdistal structure on heavy falcate spines in polydorin spionids (fig. 5g).

limbate chaetae (preferred term for Serpulidae): capillary chaetae with limbus. N.B., the same as hooded chaetae in Sabellidae.

limbus (preferred term for Serpulidae): distal extension of capillary chaetae; appearing as a flattened longitudinal flange under the compound microscope, but made of tightly packed microfibrils as seen under SEM. N.B., the same as hood in Sabellidae.

lobate: subdivided into lobes (fig. 5h).

M

main fang (Sabellidae and Serpulidae): largest fang (or tooth) of an uncinus, surmounted by row(s) of much smaller teeth (fig. 6a).

male horns (Spionidae): a pair of dorsal appendages on segment 2 in *Pygospio* males (fig. 6b).

median antenna (Spionidae): see **occipital antenna**.

N

narrowly hooded (Sabellidae): capillary chaetae with the distal hood (limbus) only on 1 side of the shaft (fig. 6c); see **limbate chaetae**.

neurochaetae: chaetae of neuropodia (fig. 6d).

neuropodium (**pl. neuropodia**): ventral branch or ramus of a parapodium (fig. 6d).

notochaetae: chaetae of a notopodium (fig. 6e).

notopodium (**pl. notopodia**): dorsal branch or ramus of a parapodium (fig. 6e).

nuchal organs: paired ciliated sensory organs on the prostomium; in Spionidae extending over dorsal side of certain anterior segments as ciliary bands, entire or metameric (fig. 6f).

nuchal papilla (Spionidae): see **occipital antenna**.

O

occipital antenna (Spionidae): a short median appendage on the prostomium (fig. 6f).

operculum (**pl. opercula**) (Serpulidae): tip of modified radiole used to plug the tube when the worm is retracted (fig. 6g).

opercular endplate (Serpulidae): terminal reinforcement of operculum, often chitinous or calcareous (fig. 7a).

P

paleate (Sabellidae): broadly hooded (bilimbate) capillaries with the shaft not reaching the tip of the chaetae.

palmate: having lobes radiating from a common point (fig. 7b).

palps: a pair of feeding and/or tactile appendages arising from the head or anterior end of body (fig. 7c).

parapodium (**pl. parapodia**): fleshy lateral projection from a body segment; usually bearing chaetae (fig. 7d).

peduncle (Serpulidae): modified radiole bearing the operculum (fig. 7e).

peduncular wings (Serpulidae): see **distal wings**.

peristome (Serpulidae): collar-like widening of tube; former tube mouth (fig. 7f).

peristomium: anterior body region surrounding the mouth and located posterior to and/or below the prostomium (fig. 7g).

pinnules (Sabellidae and Serpulidae): small ciliated paired outgrowths located along from the inner edge of the radioles, giving each radiole a feathery appearance (fig. 7h).

prostomium: anteriormost presegmental region of body; usually bearing radioles and sensory organs such as palps, antennae, nuchal organs and eyes.

posterior peristomial ring (Sabellidae and Serpulidae): posterior part of the peristomium; may bear a membranous collar.

pseudoperculum (**pl. pseudopercula**) (Serpulidae): modified radiole, generally without pinnules; can develop into a new functional operculum when the functional operculum is lost (fig. 7i).

pygidium: postsegmental terminal body part surrounding the anus (fig. 7j).

R

radiolar crown (Sabellidae and Serpulidae): anterior part extended outside the tube and used for feeding and respiration; of prostomial origin and made of pinnulated radioles attached to radiolar lobes around the mouth (fig. 8a).

radiolar eyes (Sabellidae and Serpulidae): ocelli found in the radiolar crown; can vary in number, arrangement and structure (fig. 8b).

radiolar flanges (Sabellidae): paired, lateral membranous extensions along outer margins of radioles (fig. 8c).

radiolar lobes (Sabellidae and Serpulidae): proximal part of the radiolar crown attached to the anterior end of the body; generally arranged as 2 semicircles, 1 on each side of the mouth, but forming spirals in some species (fig. 8d).

radioles (Sabellidae and Serpulidae): filaments making up the radiolar crown; attached to the radiolar lobes and bearing rows of paired ciliated pinnules (fig. 8e).

radius (**pl. radii**) (Serpulidae): radial projection of the funnel (genera *Hydroides* and *Serpula* only) (fig. 8f).

ramus: a branch.

rasp-shaped uncini (Sabellidae and Serpulidae): with 2 or more rows of teeth (fig. 8g).

recurved spines (Spionidae): heavy chaetae with distal parts bent backwards, found in notopodia of posterior segments (fig. 8h).

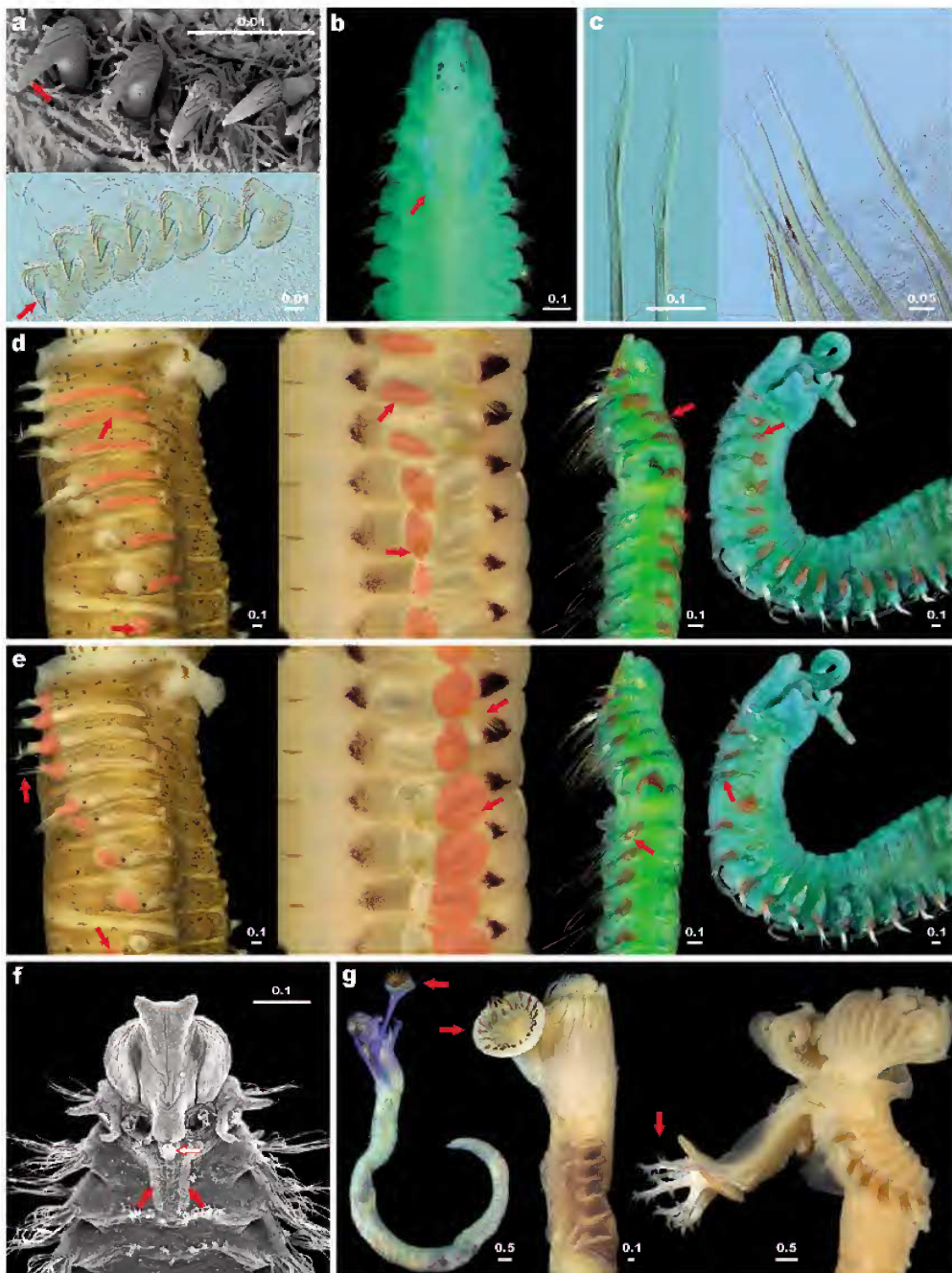


Figure 6. (a) Thoracic uncini of *Desdemona aniara* (above, SEM image) and *Laonome triangularis* (below); arrows indicate main fangs. (b) A pair of dorsal horns (indicated by arrow) on chaetiger 2 of a male of *Pygospio elegans*. (c) Narrowly hooded thoracic chaetae of *Sabellastarte australiensis*. (d) Thoracic neuropodia highlighted red on (left to right, respectively) *Branchiomma bairdi*, *Bispira manicata*, *Boccardiella bihamata* (stained with methyl green) and *Boccardia proboscidea* (stained with methyl green); arrows indicate neurochaetae. (e) Thoracic notopodia highlighted red on (left to right, respectively) *Branchiomma bairdi*, *Bispira manicata*, *Boccardiella bihamata* (stained with methyl green) and *Boccardia proboscidea* (stained with methyl green); arrows indicate notochaetae. (f) SEM image of dorsal anterior end of *Polydora cornuta*. Red arrows indicate a pair of nuchal organs; outlined arrow indicates occipital antenna. (g) Arrows indicate opercula of (left to right, respectively) *Hydroides norvegicus* (stained with methylene blue), *Ficopomatus enigmaticus* and *Spirobranchus tetraceros*. All scales in mm.

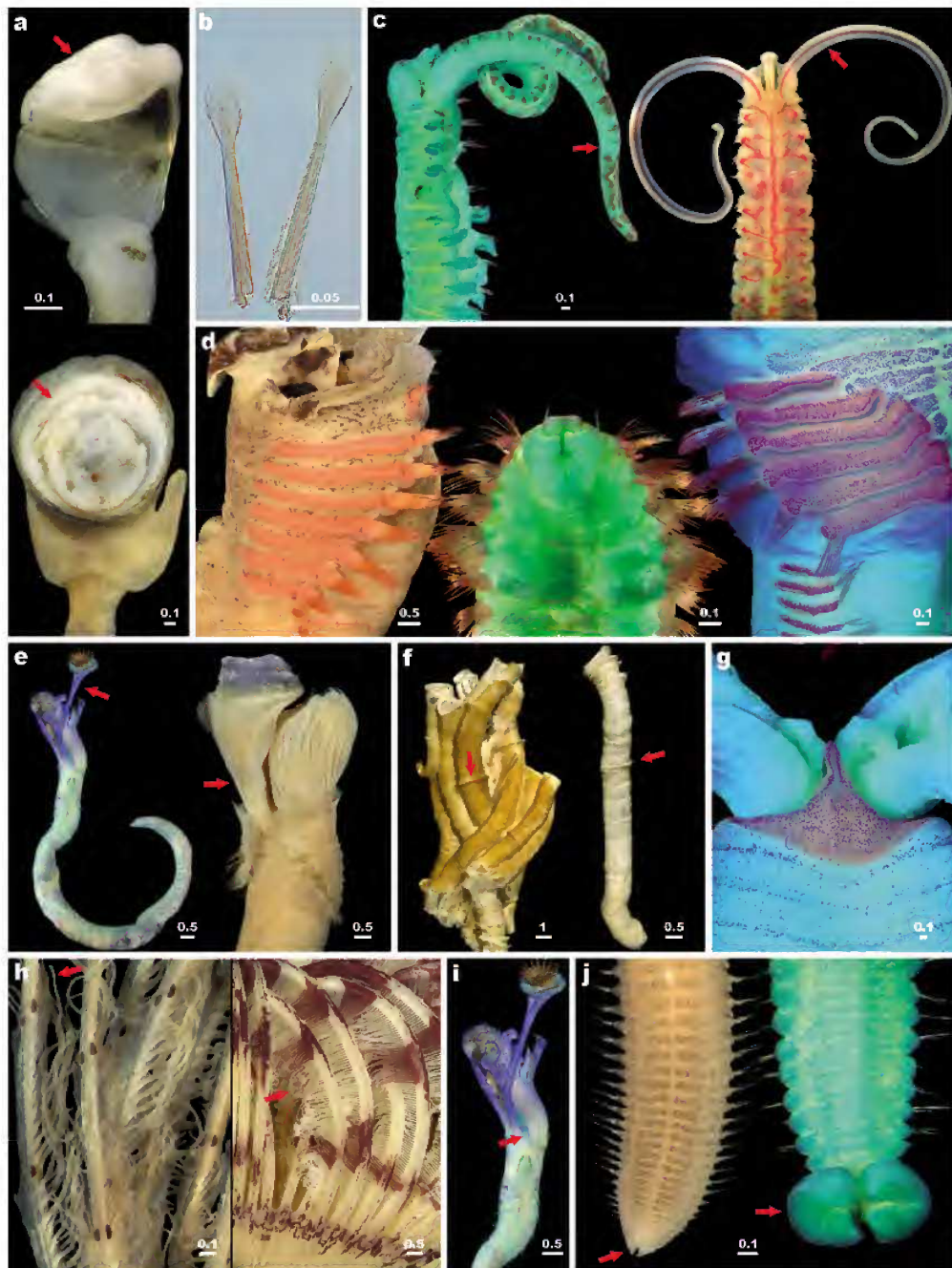


Figure 7. (a) Operculum of *Spirobranchus minutus* (above) and *Spirobranchus kraussii* (below); arrows indicate opercular endplate. (b) Paleate collar chaetae of *Laonome triangularis*. (c) Arrows indicate palps of *Polydora haswelli* (stained with methyl green) and *Boccardia proboscidea* (live specimen). (d) Parapodia highlighted red in (left to right, respectively) *Sabellastarte australiensis*, *Boccardiella bihamata* (stained with methyl green) and *Spirobranchus cariniferus* (stained with methylene blue). (e) Arrows indicate peduncle of *Hydroides norvegicus* (stained with methylene blue) and *Spirobranchus cariniferus*. (f) Tubes of *Ficopomatus enigmaticus* and *Ficopomatus uschakovi*; arrows indicate peristomes. (g) Collar region/base of radiolar crown in *Myxicola infundibulum* stained with methylene blue; peristomium highlighted red. (h) Radioles of *Bispira serrata* and *Bispira porifera*; arrows indicate individual pinnules. (i) Anterior end of *Hydroides norvegicus* (stained with methylene blue); arrow indicates pseudopericardium. (j) Arrows indicate pygidium of *Bispira serrata* and *Boccardia polybranchia* (stained with methyl green). All scales in mm.

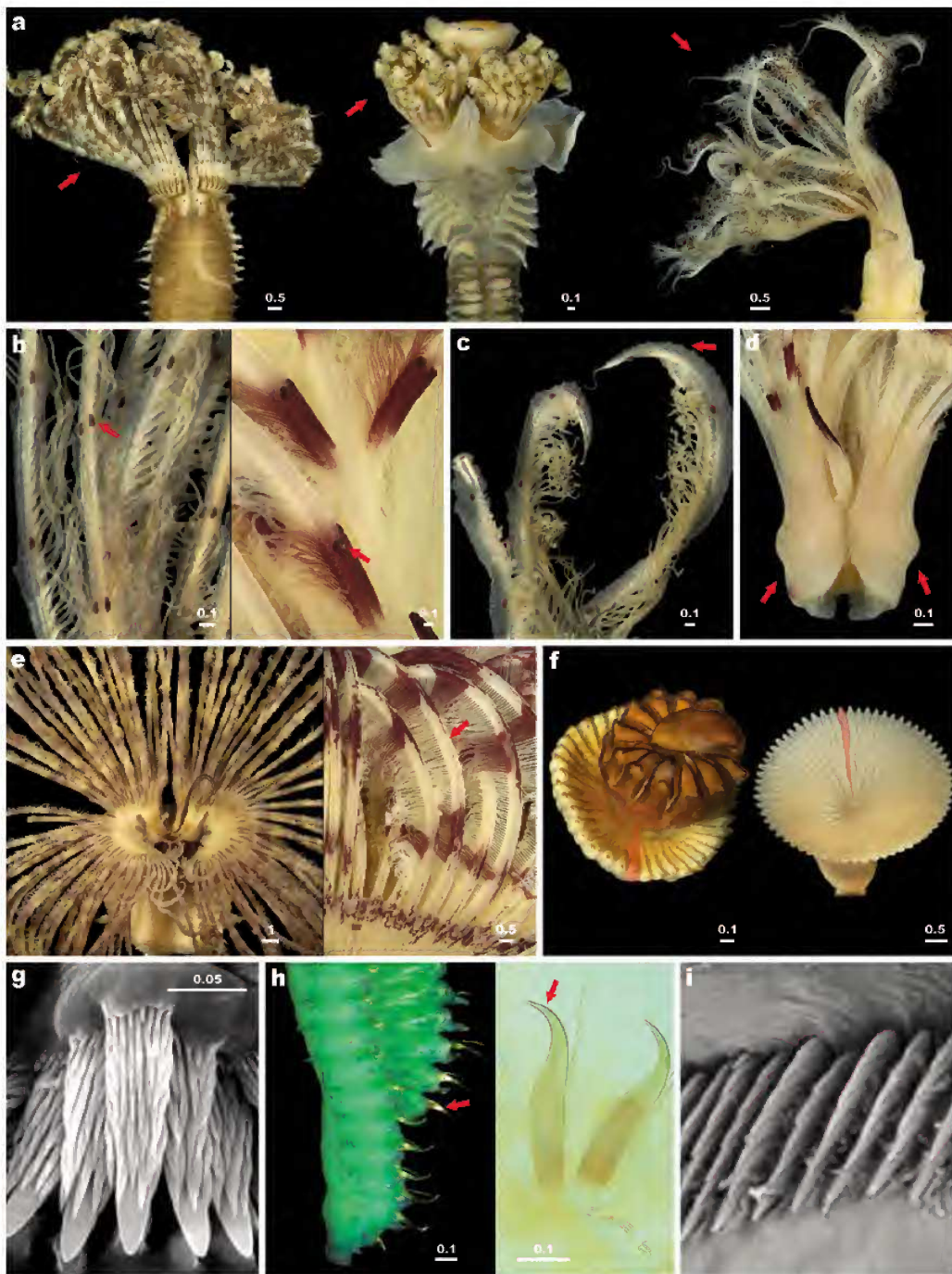


Figure 8. (a) Radiolar crowns in (left to right, respectively) *Branchiomma bairdi*, *Spirobranchus kraussii* and *Euchone variabilis*. (b) Radioles of *Bispira serrata* and *Bispira manicata*; arrows indicate radiolar eyes. (c) Arrow indicates radiolar flange on *Bispira serrata*. (d) Radiolar crown of *Bispira manicata*, consisting of 2 radiolar lobes (arrows). (e) Radiole filaments of *Sabellastarte australiensis* and *Bispira porifera*. (f) Single radius highlighted red in *Hydroides brachyacanthus* and *Serpula jukesii*. (g) SEM image of rasp-shaped posterior abdominal uncini in *Serpula columbiana*. (h) Recurved spines in posterior notopodia of *Boccardiella bihamata* (on left, stained with methyl green) and *Polydora uncinata* (on right). (i) SEM image of saw-shaped thoracic uncini on *Serpula columbiana*. All scales in mm.

S

saw-shaped uncini (Serpulidae): with only 1 row of teeth (fig. 8i).

sedentary: attached to a surface and not moving freely.

segment: 1 of the serially repeated units comprising the trunk; often separated internally by septae or dissepiments (fig. 9a).

shaft: proximal smooth part of chaetae, partly embedded in the tissue; also see **handle**.

spine-like chaetae (Sabellidae): narrowly hooded capillaries (also see **limbate chaetae**). N.B., not the same as falcate spines and recurved spines of Spionidae.

spinules (Serpulidae): each of the tubercular or tooth-like projections of a spine in the verticil of the genus *Hydroides* (fig. 9b). By their position relative to the axis, spinules may be internal, lateral or external. By their position along the spine, spinules may be proximal, medial or distal.

Spirobranchus-type chaetae (Serpulidae): special collar chaetae with a 'fin' positioned below the distal limbus (hood) and consisting of numerous tiny hair-like spines (fig. 9c).

stylodes (Sabellidae and Serpulidae): outward projections from the outer margin of radioles; can be digitiform (cylindrical or finger-like), strap-like (flattened) or palmate (branched and flattened); always paired in Sabellidae, unpaired in Serpulidae (fig. 9d).

T

thoracic membrane (Serpulidae): thin folds on both sides of thorax, extending from dorsal part of collar to lateral and/or ventral side of posterior thorax (fig. 9e).

thorax: anterior region of the body behind the head (fig. 9f).

tonguelet (Serpulidae): special form of lappet, between dorsolateral and ventral lobes of the collar in some serpulid genera (fig. 9g).

torus (pl. tori) (Sabellidae and Serpulidae): transverse elevation of parapodium surrounding the uncini (fig. 10a).

triangular depression (Serpulidae): depressed area between thoracic uncinigerous tori which gradually approach and almost touch one another posteriorly and ventrally (fig. 10b).

true trumpet-shaped chaetae (Serpulidae): distally hollow chaetae, with 2 parallel rows of sharp denticles, extending into a long lateral spine (fig. 10c).

tube: protective structure completely enclosing the body in some polychaete families; made of mucus often covered by sediment particles (Sabellidae, Spionidae) or calcium carbonate (Serpulidae, exceptionally Sabellidae) (fig. 10d).

U

uncinigerous (Sabellidae and Serpulidae): bearing uncini.

uncinus (pl. uncini) (Sabellidae and Serpulidae): small modified hook-shaped or comb-shaped chaeta deeply

embedded into tissue, with only its dentate edge protruding from the body wall; uncini usually arranged in tori in transverse elevated rows (fig. 10e).

V

ventral: lower or underside of the body; side of the polychaete body bearing the mouth.

ventral lips (Sabellidae): membranous lappets on both lateroventral sides of mouth (fig. 10f).

ventral radiolar appendages (Sabellidae): modified radioles generally lacking pinnules; located on the ventral edge of the radiolar lobes.

ventral sacs (Sabellidae): vesicles filled with sediment used for tube building; located between the radiolar lobes (fig. 10g).

ventral shields (Sabellidae and Serpulidae): epidermal glandular areas on ventral side of the thorax; well-defined or diffused (fig. 11a).

verticil (Serpulidae): distal part (usually a crown of chitinous spines) of operculum in *Hydroides* (fig. 11b).

verticil spine (Serpulidae): radial elements together forming the verticil in *Hydroides* (fig. 11b).

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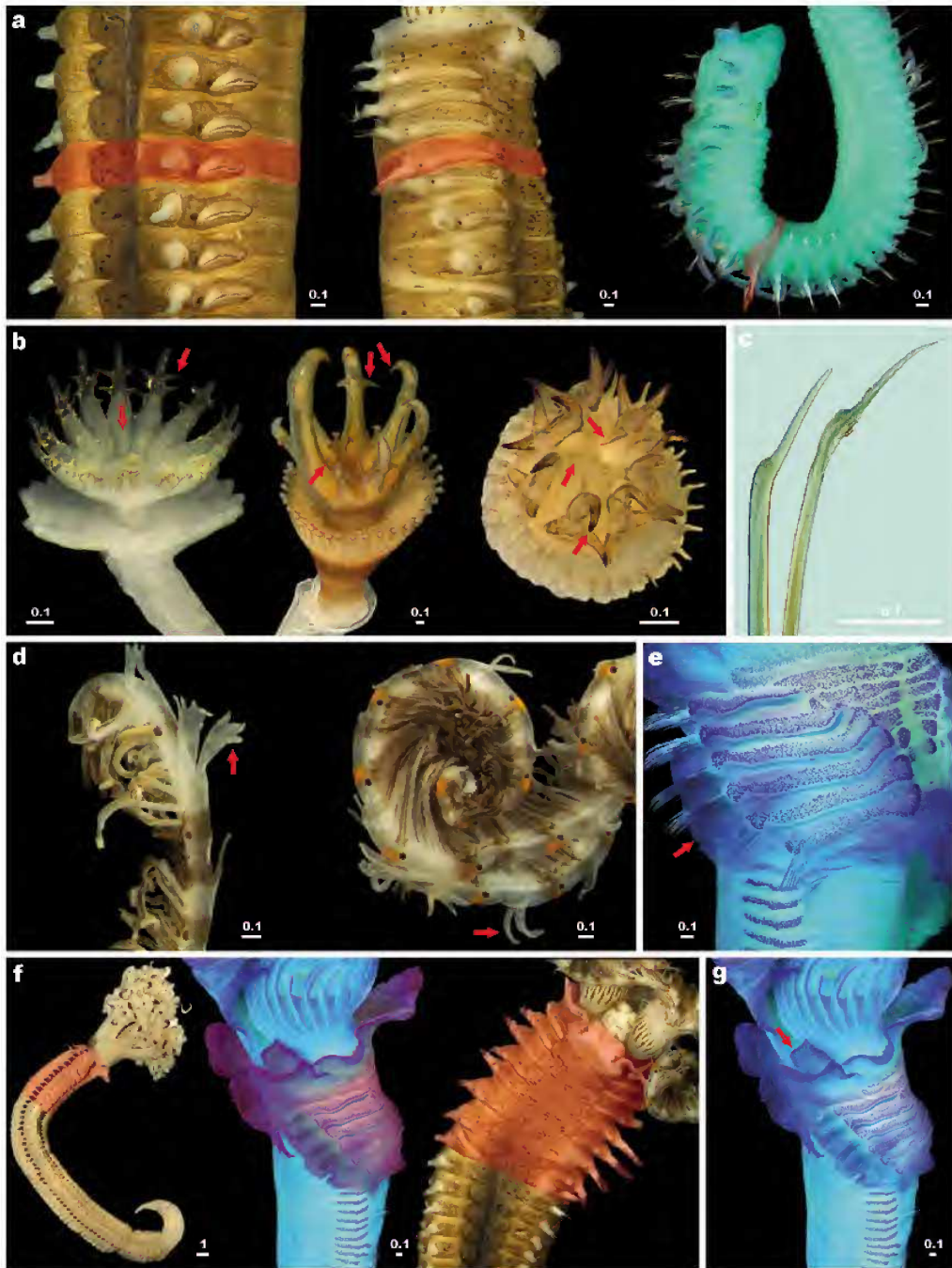


Figure 9. (a) Single segments of *Branchiomma bairdi* (left 2 images) and *Polydora haswelli* (stained with methyl green) highlighted red. (b) Arrows indicate spinules on opercula of (left to right, respectively) *Hydroides elegans*, *H. heteroceros* and *H. tambalagamensis*. (c) *Spirobranchus*-type collar chaetae from *Spirobranchus tetraceros* (stained with methyl green). (d) Radioles of *Branchiomma galei* and *Branchiomma bairdi*; arrows indicate stylodes (palmate in *B. galei* and simple in *B. bairdi*). (e) Arrow indicates thoracic membrane of *Spirobranchus cariniferus*, stained with methylene blue. (f) Thorax regions (highlighted red) of (left to right, respectively) *Bispira manicata*, *Spirobranchus cariniferus* (stained with methylene blue) and *Branchiomma bairdi*. (g) Arrow indicates tonguelet of *Spirobranchus cariniferus* (stained with methylene blue), partially covered by collar. All scales in mm.

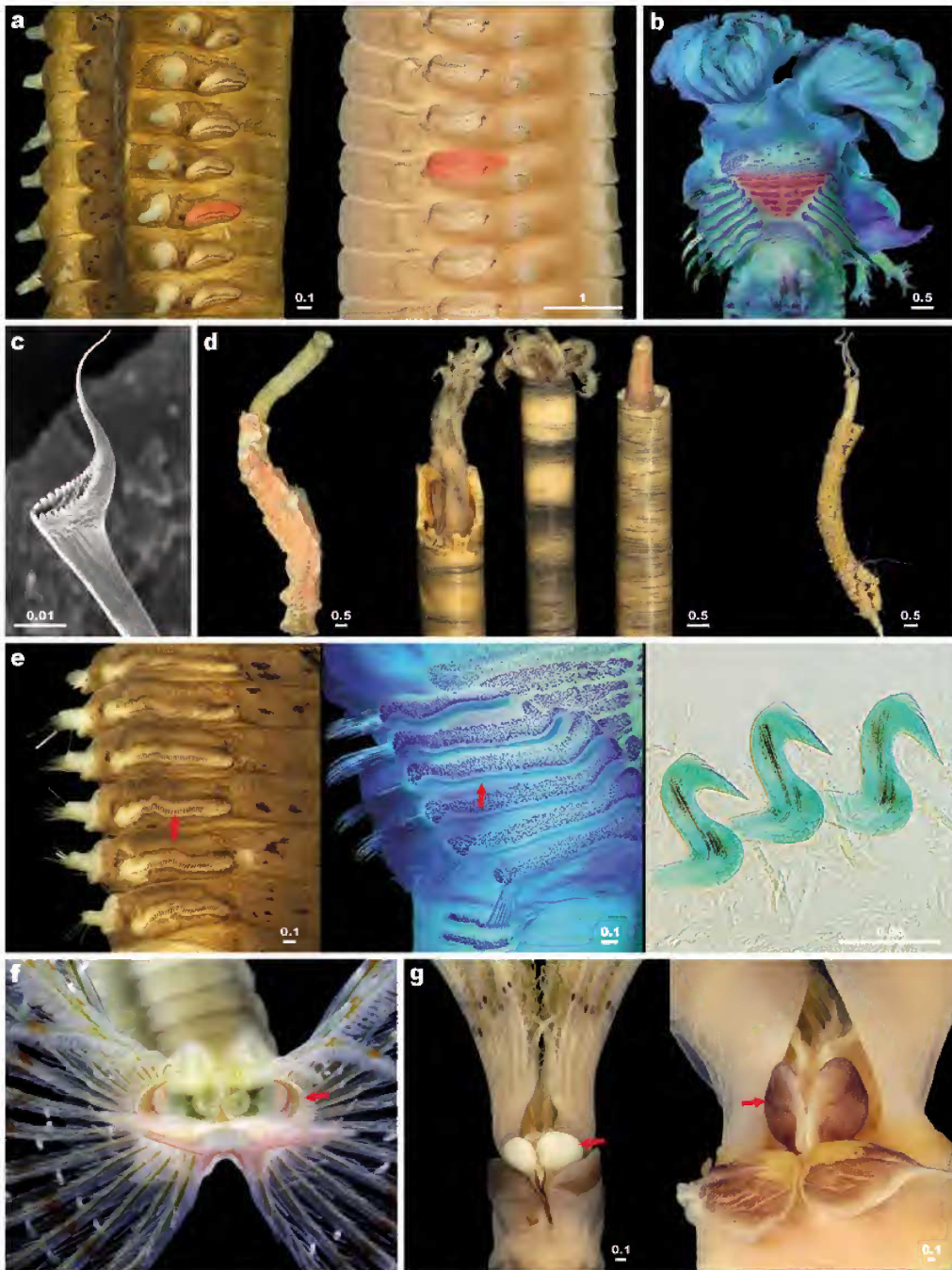


Figure 10. (a) Tori of *Branchiomma bairdi* and *Sabella spallanzanii* highlighted red. (b) Triangular depression in *Spirobranchus tetraceros* (stained with methylene blue) highlighted red. (c) SEM image of true trumpet-shaped chaetae of *Spirobranchus giganteus*. (d) Tubes of (left to right, respectively) *Spirobranchus taeniatus*, *Bispira serrata* and *Pseudopolydora paucibranchiata*: calcareous in Serpulidae (*S. taeniatus*) and muddy in Sabellidae (*B. serrata*) and Spionidae (*P. paucibranchiata*). (e) Uncini of (left to right, respectively) *Branchiomma bairdi*, *Spirobranchus cariniferus* (stained with methylene blue), and close-up in *Bispira manicata* (stained with methyl green). (f) Arrow indicates ventral lip in live specimen of *Branchiomma arctica* (photo: © Alexander Semenov). (g) Collar region of *Bispira serrata* and *Sabella spallanzanii*; arrows indicate ventral sacs. All scales in mm.

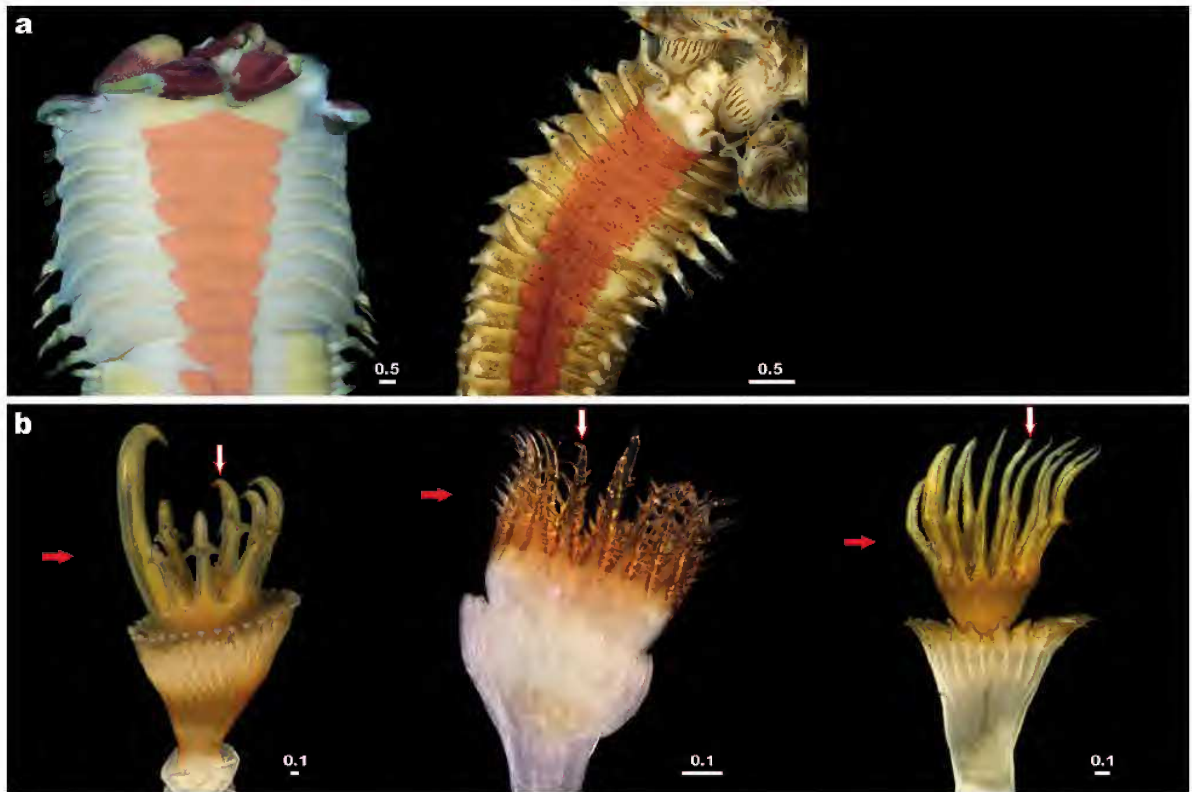


Figure 11. (a) Ventral shields of *Bispira porifera* (stained with methylene blue) and *Branchiomma bairdi* highlighted red. (b) Opercula of (left to right, respectively) *Hydroides heteroceros*, *H. longispinosus* and *H. sanctaecrucis*; red arrows indicate verticil; outlined arrows indicate verticil spines. All scales in mm.

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